Improvement of the Degradation of Methyl Orange Using a TiO₂/BDD Composite Electrode to Promote Electrochemical and Photoelectro-Oxidation Processes

Martin O. Pacheco-Álvarez¹, Oscar M. Rodríguez-Narváez¹, Kazimierz Wrobel¹,
Ricardo Navarro-Mendoza¹, José L. Nava-Montes de Oca², Juan M. Peralta-Hernández^{1,*}

¹ Departamento de Química, División de Ciencias Naturales y Exactas, Campus Guanajuato, Universidad de Guanajuato, Guanajuato, Gto 36050, México

² Departamento de Ingeniería Geomática e Hidráulica, Universidad de Guanajuato, Av. Juárez 77, Zona Centro, C.P 36000 Guanajuato, Guanajuato, México

*E-mail: juan.peralta@ugto.mx, www.ugto.mx

doi: 10.20964/2018.12.70

Received: 7 September 2018 / Accepted: 1 October 2018 / Published: 5 November 2018

Electrophoretic deposit of titanium dioxide (TiO₂) was carried out over a boron doped diamond plate of 2 cm², annealing at 350 °C to produce binary TiO₂/BDD composite electrode. The composite was characterized by scanning electron microscopy (SEM) and linear sweep voltammetry (LSV) response. N,N-dimethyl-p-nitrosoaniline (RNO) was used as a probe molecule for the detection of free radicals (•OH) during the oxidation of water in phosphate buffer (pH 4) solution; at the TiO₂/BDD/hv composite, an apparent first-rate kinetic constant of $k_{obs} = 0.1314 \text{ min}^{-1}$ was observed. Afterwards, the composite electrode was applied to degrade 40 and 100 mg L⁻¹ of a typical azo dye methyl orange (MO) via electrochemical process, such as: electro-oxidation (EO) and photoelectro-oxidation (PEO) under 25, 75 and 125 mA cm⁻² current density (j); the PEO tests were performed using a UVA lamp at 365 nm. Results showed that the discoloration in the PEO process was larger than in the EO process, 96 and 100 %, respectively. Chemical Oxygen Demand (COD) was tested to evaluate the degradation. Hydroxylated derivatives were identified by means of mass spectroscopy during the PEO of MO in a TiO₂/BDD/hv composite electrode.

Keywords: TiO₂/BDD composite, hydroxyl radical formation, electrochemical process, water treatment, azo dye.

[FULL TEXT](#)

© 2018 The Authors. Published by ESG (www.electrochemsci.org). This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).